LEPIDOPTERA HETEROCERA

FAM. GEOMETRIDÆ

INTRODUCTION — SUBFAM. BREPHINÆ

by Louis B. PROUT

WITH 1 COLOURED PLATE

INTRODUCTION TO THE STUDY OF THE FAMILY

THE family *Geometridae* has been recognized as a natural and generally well-defined section of the Lepidoptera ever since the institution of our modern system of nomenclature by Linnæus in 1758. In the tenth edition of his *Systema Naturae* (Vol. 1, p. 496) the great Swede proposed dividing his unwieldy genus *Phalaena*, for convenience of reference, into seven sections — or, in modern phraseology, subgenera — the third of which was « Geometræ », characterized as « Alis patentibus horizontalibus quiescentes », and subdivided again primarily according to the structure of the antennæ (« pectinicornes » and « seticornes ») and secondarily according to the form of the hindwings (« angulatis » or « rotundatis »). As a further distinction of the Geometræ — and that from which their name was derived — he noted that the larvæ possessed only ten legs, resulting in (or resulting from) their peculiar and characteristic mode of progression. Linnæus never used the name *Geometra* in the singular, except trinomially in conjunction with *Phalaena ;* and he continued to use *Phalaena* as the binomial (see p. 502, « Facies *Ph. jacobaeae* », etc., etc. ; also Amoen. Acad., passim). Considering how small a proportion of the larvæ was then known, he showed a very true perception of the Geometrid character, though he included a few slender-bodied species of other families which have since had to be removed, such as the species of *Drepana*, *Eurhypara*, *Nymphula* and *Nyctemera*, and (very excusably) excluded *Dysphania militaris*.

Fabricius in 1775 (*Syst. Ent.* p. 619) first raised the *Geometridae* to full generic rank, although he here (and until his Supplementum of 1798) united them with the *Pyralidae*. He used the generic name *Phalaena* for this restricted section of the Heterocera, and there can be little doubt that the

comparatively few subsequent authors who have followed him in his nomenclature have acted according to the letter of the law of zoological nomenclature (1), and that, strictly speaking, the family should be called *Phalaenidae* rather than *Geometridae;* but inasmuch as several prominent Lepidopterists have agreed to treat the name *Phalaena* (*Phalaenae*) as of *super*-family value, it has been thought expedient. in a work which is the joint production of many collaborators, to adhere to the more commonly-used name of *Geometridae*. Schiffermüller, later in 1775 (*Syst. Verz. Schmetterl. Wiener Gegend*, p. 95-117), and Kluk in 1780 (*Zwierz. Hist. Nat.* Vol. 4, p. 102) commenced to use *Geometra* binomially for this family in a purified form.

The first attempt to subdivide the *Geometridae* proper into genera was made by Haworth in 1802. In his *Prodromus Lepidopterorum Britannicorum* he restricted *Geometra* (p. 20) to the species having « Antennæ masculinæ pectinatæ. Larva geometra. Corpus rarissime crassum »; and used *Phalaena* (p. 24) for those having « Antennæ, oculo inarmato, setaceæ. Corpus semper gracile. Larva geometra. »

In the same year two other authors, believing themselves to be dealing with other branches of the Lepidoptera, introduced genera which have to be considered in relation to Geometrid classification. These were Latreille (*Hist. Nat. Crust. et Ins.* Vol. 3, p. 415), who erected a genus *Botys*, and Schrank (*Fauna Boica*, Vol. 2 (2), p. 162), who provided *Scopula* for *paludalis* (= *ornata*, Scopoli) and *dentalis*, placed in the order in which they are here given, and the former alone agreeing with the diagnosis, therefore declared type (*The Entomologist*, Vol. 39, p. 266). The question of *Botys*, Latreille, is somewhat more complicated, but it is shown elsewhere (*The Entom. Record*, Vol. 20, p. 141) that the type is *angustalis*, Schiffermüller, and that its employment in the *Geometridae* by Moore and Kirby is due to misapprehension.

Hübner in his *Tentamen determ. digest. Lepid.*, in 1806, divided the *Geometridae* into seventeen uncharacterized « Stirpes », the beginning of a classificatory scheme which was developed in his later works. As each Stirps name was unfortunately used in the singular number and in binomial conjunction with the name of one species (as an illustration of it), several eminent entomologists have held them to be valid genera; but on account of the absence of proof that the *Tentamen* was really published, besides a number of other weighty considerations, the majority has decided against them, and to this decision we here bow.

Leach in 1814 (*Zool. Miscell.* Vol. 1, p. 79) extracted one genus, *Ourapteryx,* from the heterogeneous mass, and the following year (*Edinb. Encycl.* Vol. 9 (1), p. 134) he gave his full scheme of classification of the « tribe » (family) *Phalaenides*. He adopted five « families » (subfamilies), the first two of which were *Phalaenida* and *Geometrida* (*Phalaeninae* and *Geometrinae* in modern nomenclature), and erected in these a few indifferently-characterized genera which marked at least some slight advance in classification. The *Phalaenida* (« larvæ with twelve feet ») comprised only the genus *Phalaena*, typified by *P. margaritata*, Linnæus, but the names, subfamily and generic, are untenable; the *Geometrida* (« larvæ with ten feet ») were divided into six genera : *Biston*, *Geometra*, *Ourapteryx*, *Abraxas, Bupalus* and *Hipparchus*, according to the ♂ antennæ, palpi, build of body, shape of wings and their position at rest. His *Geometra* corresponded to the typical section as established by Lamarck in 1801 (see infra), the other five offered valid new conceptions.

Lamarck in 1816 (*Hist. Nat. Anim. sans Vert.* Vol. 3, p. 568) erected *Campaea* for the « Phalénides » with an extra pair of claspers, and although he included under his genus several Noctuids, of the genera *Plusia* and *Euclidia,* Stephens' perfectly legitimate restriction of it to the first species, *margaritata*, Linnæus, necessitates its mention here (= *Phalaena*, Leach, in err.).

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(1) *International Code of zoological Nomenclature*, art. 29 : « If a genus is divided into two or more restricted genera, its valid name must be retained for one of the restricted genera. »

Treitschke in 1825 (*Die Schmetterlinge von Europa*, Vol. 5 (2), p. 421, seq.) gave his scheme of Geometrid classification, applying generic names to the unnamed sections into which Schiffermüller and Borkhausen had divided the Geometræ, and adding a few others without diagnoses, the descriptive work being postponed to a later volume (Vol. 6, 1827-28). In unfortunate ignorance of Leach's work, he proposed to restrict the name *Geometra* to Schiffermüller's Family B, the « emeralds » of English writers, the *Hemitheinae* of the present work. The remainder of his genera are *Ennomos, Acaena* (synonym of *Ourapteryx*, Leach), *Ellopia*, *Aspilates* (later written *Aspilates*), *Crocallis*, *Gnophos*, *Boarmia*, *Amphidasis*, *Psoidos* (later written *Psodos*), *Fidonia*, *Chesias*, *Cabera*, *Acidalia*, *Larentia*, *Cidaria*, *Zerene* (synonym of *Abraxas*, Leach), *Minoa* and *Idaea*. Most of these have passed into general currency, and some have been made the types of subfamilies.

In the same year (1825) Latreille (*Fam. Natur. du Règne animal*, p. 477) separated from the typical « *Phalaenites* » two genera, which were supplied with latinized names by Berthold in 1827 (*Fam. Thierr.* p. 484, 485); these were *Metrocampus* (gen. cælebs; synonym of *Campaea*, Lamarck) and *Hybernia* (gen. cælebs; « femelles aptères ou semi-aptères, ne pouvant voler »).

Later in 1825, or more probably not until 1826, appeared Hübner's noteworthy *Verzeichniss bekannter Schmettlinge*. It is just possible that this work was issued in parts at irregular intervals between 1818 and 1826, but in any case there is positive proof that the Geometrid portion did not appear before August 27, 1825, at earliest, and its correct location, for questions of priority, will certainly be between Treitschke's fifth volume (part 2) and Berthold; the only serious chronological difficulty that can arise is in regard to three of Curtis' genera published in 1826 (*Brit. Ent.* Vol. 3), viz. : *Charissa* (Febr. 1, 1826), *Alcis* (Apr. 1, 1826) and *Macaria* (Sept. 1, 1826). Hübner elaborated a complete scheme of classification, the seventeen Stirpes of his *Tentamen* being subdivided into many familiæ and coitus, the latter furnishing the binomials, and corresponding to the « genera » of other authors. The characters upon which his divisions were founded were superficial in the extreme, mostly wing-pattern or colour, or at best shape, although in one or two instances the hairiness of the body or the armature of the legs is mentioned. As a result of this superficiality, many of the genera are very incongruous; but very often Hübner's intimate acquaintance with the Lepidoptera enabled him to grasp the natural groupings in spite of the defectiveness of his characterizations. It has been proposed, by Grote, Tutt and others, to employ his stirps names, with modified endings, for the nomenclature of the modern families and subfamilies; but inasmuch as they are not founded upon valid generic names — those of the *Tentamen* having been decided to be inadmissible — this would be against the International Rules of Zoological Nomenclature.

Curtis (*Brit. Ent.*, 1824-39), Duponchel (*Hist. Nat. Lép.* Vol. 7 (2), 1829), Stephens (*Ill. Haust.* Vol. 3, 1831), Boisduval (*Gen. et Ind. Meth.*, 1840) and others added very many to the existent generic names, all of them ignoring those of Hübner's *Verzeichniss*, though Stephens later adopted them. Details cannot here be given, and it is doubtful whether they imply much real advance in generic classification. But in Oken's *Isis* for 1838 (p. 313), 1839 (p. 107-110) and 1843 (p. 244-264) Speyer gave some very important contributions, revising Treitschke's genera from the point of view of leg-structure and other good characters; and contemporaneously Herrich-Schäffer gave his first working-out of the *Geometridae* (Panzer's *Deutsch. Ins.* Heft 165 seq., 1839), introducing that venation system which he further elaborated in his *Systematische Bearbeitung*, Bde. 3 and 6 (1847-56), and which, in the hands of Lederer (*Die Spanner*, 1853), became the parent of the very useful Meyrick-Hampson classification which will be largely followed in the present work.

Duponchel's *Catal. Méth. Lépid. Eur.* (published in September, 1845, not in 1844 as given on the title-page) was intermediate between Herrich-Schäffer's earlier and later works. No use was made in it of the researches of Speyer and Herrich-Schäffer, no dichotomous tables of genera

were given, and the diagnoses were founded chiefly on the antennæ, palpi, tongue and form of wing. The family was described as the « tribe » *Phalaenidae*, and was divided into eighteen « sub-tribes » (= subfamilies), with French names terminating in « -ites » (Ennomites, Chlorochromites, etc.) and usually a Latin equivalent in *-idi* added from Guenée's manuscripts (*Ennomidi,* Guenée in litt., etc.). Stephens in 1850 (*List Brit. Anim. Brit. Mus.* Vol. 5) adopted these as subfamilies, with uniform termination in *-idi*, and added four new ones, but the list is absolutely devoid of diagnostic matter. The Hübnerian genera were accepted, usually in subgeneric sense.

Bruand in 1846 (*Mém. Soc. Émul. Doubs*, Vol. 2 (2), p. 68) again reclassified the family in a superficial manner, making primary use of the old Linnæan character of the ♂ antennæ. Cohors I, with these pectinated or ciliated, comprised three « tribes » : *Amphidasidæ*, *Ennomidae* and *Fidonidae*, according to wing-form; cohors II, « antennæ simplices », contained two tribes, *Urapteridae* and *Cidaridae* (nom. præocc.; *Cidarites*, Lamarck, 1816 = *Cidaridea*, Gray, 1827 = *Cidaridae*, Forbes, 1844), also according to wing-form. Fifteen « subtribes » were recognized (also terminating in *-idae*), but almost all uncharacterized.

Herrich-Schäffer (*Syst. Bearb. Europ. Schmett.* Vol. 3, p. 5) characterized the « *Geometrides* » as having setiform antennæ, undivided wings, the forewing with one, the hind with at most two free inner-marginal veins and with a frenulum; two palpi, no ocelli, and the larvæ with only two (or in only a few species four) ventral legs, but always with the anal claspers developed. He considered only two subfamilies (Zünfte) available by accurate division, and proposed to call them *Phytometrides* and *Dendrometrides*. At first (p. 7) he intended to differentiate the former upon the full development of vein R^2 of the hindwing, and included therein such genera as his *Geometra* and *Acidalia*; but later (p. 38) he changed his view, and diagnosed the *Phytometrides* as having vein C of the hindwing anastomosed with the cell until near its end : thus really discovering the threefold division of the family (cfr. Meyrick, *Trans. Ent. Soc. Lond.* p. 57, 1892) while adhering to his arbitrary twofold plan. His genera were for the most part thoroughly well founded, a considerable number of structural characters being employed.

Lederer (*Die Spanner*, 1853) proposed to substitute four groups for Herrich-Schäffer's two : group I, with vein R^2 of hindwing well developed, C not anastomosing with the cell, R^2 of all wings much nearer to R^1 than to R^3, became the *Geometridae* (s. str.) of Meyrick = *Geometrinae* of Hampson (*Faun. Brit. Ind. Moths*, Vol. 3, p. 466); group II, with the first-named characters as above, but with R^2 midway between R^1 and R^3, the precursor of the *Sterrhinae* of Meyrick = *Acidaliinae* of Hampson (tom. cit. p. 425); group III, with R^2 of the hindwing weak or wanting, the *Selidosemidae* of Meyrick = *Boarmiinae* of Hampson (tom. cit. p. 139); and group IV, with C of hindwing stron ly anastomosing with the cell, the *Hydriomenidae* of Meyrick = *Larentiinae* of Hampson (tom. cit. p. 329). He also gave as absolute a distinction which, though important, is not invariable, the presence of an areole (or accessory cell, vide infra) in the forewing in groups II and IV and its absence in groups I and III. Meyrick, in different papers, added two other families : the *Oenochromidae*, or *Monocteniadae* (*Oenochrominae* Hampson, tom. cit. p. 313), with C of hindwing free and R^2 present, not approximated to R^1; and the *Desmobathridae*, or *Orthostixidae* (*Orthostixinae*, Hampson, tom. cit. p. 318), with C of hindwing connected with cell by a bar near the base, R^2 present.

Some good classificatory work proceeding more or less on the same lines as Herrich-Schäffer's and Lederer's has been given by von Heinemann (*Schmett. Deutschl.* Vol. 1, 1859), Snellen (*Vlind. Ned., Macrolep.* 1867) and Aurivillius (*Nord. Fjär.* 1888-91). Less satisfactory, though a certain amount of it has borne the test of half a century of use, is Guenée's « Uranides et Phalénites » (*Spec. Gén. des Lépid.* Vol. 9-10, 1858), dealing with the world's Geometridæ (« Phalénites »). These Guenée divided into twenty-six families, some well-characterized, others the reverse. The better-grounded have been retained as subfamilies by Warren (*Proc. Zool. Soc. Lond.* 1893; *Nov. Zool.* Vol. 1, seq., 1894, etc.),

and in several cases deserve at least tribal recognition. Guenée employed a considerable number of structural characters, but was much less consistent in his use of venation than his German contemporaries, and his work suffers from lack of rigid definition, and absence of tabular presentation of the characters of his families and genera.

In 1860-62 and 1866 Walker's *List Lep. Ins Brit. Mus.*, Parts 20-26 and 35, inundated nomenclature with badly defined genera, but added nothing to the history of classification, though very useful to the bibliographer.

In 1876 Packard (*Monogr. Geom. United States*) brought out an original classification of the North American *Geometridae*, embodying a large amount of anatomical research. Although he confessedly drew largely on Guenée's work, he entirely remodelled the scheme of subfamilies, reducing their number to eight only : *Larentinae* (= Lederer's groupe IV), *Fidoninae* (not well defined, though the venation is stated to be « quite characteristic »), *Caberinae* (a fairly natural group), *Goniacidalinae* (mainly Epiplemid, but with the curious Acidaliid (?) *Goniacidalia* as its type genus), *Acidalinae* (= Lederer's group II), *Geometrinae* (= Lederer's group I), *Boarminae* (= Lederer's group III, pro parte, not sharply delimited) and *Ennominae* (a fairly natural section of Lederer's group III). The forewing venation is often well figured and described, but the more reliable hindwing venation is strangely neglected. Synoptic tables of genera, though not of subfamilies, are given, but they are too uncritical to be of much use; nevertheless, as a pioneer in a previously unworked fauna, the book is of great value.

Numerous other faunistic works, containing more or less of new classification, but of secondary importance in this particular respect (such as those of Moore, Staudinger, Möschler, Butler, Druce, Swinhoe, Pagenstecher and others) must be passed over without mention. The principal recent classificatory works on the family have been those of Meyrick and Hampson, already referred to, von Gumppenberg's « Systeme Geometrarum Zonæ Temperatioris Septentrionalis » (*Nova Acta Acad. German.* Vol. 49-65, 1887-96) and Hulst's « Classification of the Geometrina of North America » (*Trans. Amer. Ent. Soc.* Vol. 23, 1896); to these may be added Poppius' two papers on the Finnish species (*Acta Soc. Faun. Flor. Fenn.*, 1887 and 1891), an important series of Australian revisions by Dr. A. J. Turner, at present in progress, and *A Review of our Geometrid Classification* (North American) by R. F. Pearsall, also in progress (*The Canad. Entom.* Vol. 36, 39), while further valuable contributions to the study will be found in Comstock's *Manual for the Study of Insects* and one or two memoirs on special subjects, such as Walter's « Palpus Maxillaris Lepidopterorum » (*Jena. Zeit. Nat.* Vol. 18). Meyrick's work is characterized by rigid precision and is very helpful for analytical purposes, although his logical application of his findings from a limited number of characters has resulted in occasional large genera which seem to the ontogenist very unnatural. Hampson's is also very valuable analytically, and whatever opinions may be held as to the exact biological significance of « secondary sexual characters », his refusal to recognize them as fully generic is at least convenient in the location of species of which one sex only is known. Hulst based his classification largely on that of Meyrick, but unfortunately abandoned that which is its chief merit — its unswerving consistency — and in very many instances his species do not conform to the characters of the genus to which he assigns them, nor even the genera to those of their subfamilies; he added to Meyrick's six subfamilies eight others, often of questionable validity or not true *Geometridae* : *Dyspteridinae* (= *Larentiinae* without a frenulum), *Brephinae* (see infra); *Fernaldellinae* (for a single genus with vein R^2 of hindwing absent and C anastomosing with cell); *Palyadinae* (R^2 of hindwing absent and frenulum absent); *Mecoceratinae* (which we accept as a tribe in the *Oenochrominae*); *Melanchroiinae* (R^2 of hindwing absent, R^2 of forewing stalked with R^1; Hulst gives another interpretation, which would place the group outside the *Geometridae*), and two which are now excluded from the family. Others which he used without characterization in Smith's and Dyar's lists of North American Lepidoptera need not be referred to here.

Poppius worked chiefly on the venation of the Finnish species, and gave a number of plates in illustration thereof. Accepting the primary division of Herrich-Schäffer's system, his earlier memoir (*Finland's Dendrometridae*) subdivides the « family *Dendrometridae* » into three « groups », which he designates *Odontoperidae*, *Boarmidae* and *Acidalidae*. The last-named comprises all the *Dendrometridae* in which vein R^2 of the hindwing is well-developed (= the *Geometridae* + *Sterrhidae* + *Monocteniadae* of Meyrick), the other two are mere sections of the *Selidosemidae* of Meyrick (vein R^2 of hindwing weak or wanting), and apparently admitted by the author to be less capable of rigid definition; the group *Odontoperidae* was intended to receive the species with acute apex, and with more or less uneven distal margin of both pairs of wings, or at least of one; the *Boarmidae* those with more rounded apex and even margins.

Von Gumppenberg repudiated venational systems, and attempted an entirely new classification, based almost exclusively on wing-form; but his work, laborious though it undoubtedly is, has never been taken seriously. He divided the family into four « acies », of which the second and third were subdivided into tribes in *-inae*.

Turner is following Meyrick rather closely, although his careful personal verification of the old facts, and analyses of the new discoveries lend a high value to his researches. Somewhat similarly, Pearsall has commenced where Hulst left off, but he is finding very much to revise and rearrange. In his first paper (*The Canad. Entom.* Vol. 36, p. 208, 209) Pearsall sunk the *Dyspteridinae* to *Hydriomeninae*, and in his second (tom. cit. p. 342, 343) he gave a synopsis of the residue, which included a characterization of those that had been left without diagnoses by Dr. Hulst, namely : *Monotaxinae*, hindwings, vein 5 present, strong, antennæ ♂ unipectinate; and *Sphecetodinae* (recte *Sphacelodinae*), hindwings, vein 5 absent, or a fold only, antennæ nearly joined at base.

Mr Warren, our leading specialist on the *Geometridae*, has published no complete systematic revision, his work in the *Novitates Zoologicae* and elsewhere being mainly devoted to the description of new genera and species; but his wide stores of knowledge of the family have been very freely drawn upon in the preparation of the present work, and a cordial acknowledgment is here made of the varied assistance received from him.

Our own working-out of the family for the Genera Insectorum will be seen to follow broadly the primary divisions of Meyrick and Hampson, these having been proved to give a practicable working basis for the provisional location of the world's *Geometridae*. We are fully alive to the fact, however, that the system is in part an artificial one, and that only two, at most, of the subfamilies (*Acidaliinae* and *Larentiinae*) seem likely to find strong phylogenetic support. Some investigations into the genitalia, which are being taken in hand by Dr. T. A. Chapman, Rev. C. R. N. Burrows and Mr. F. N. Pierce, may possibly open a new chapter in Geometrid classification; in particular, Dr. Chapman (in litt.) considers that a dichotomous arrangement is indicated thus : 1° tenth abdominal clearly marked off from ninth and distinctly articulated into dorsal and ventral pieces, suggesting a shark's jaw (typified by *Erannis*, but embracing numerous *Oenochrominae* as well as *Boarmiinae* of Hampson); 2° without this character. In the mean time the only alterations we have made in Meyrick & Hampson's scheme are the merging of the *Oenochrominae* and *Orthostixinae* (the given differential character being found entirely untenable) and the restoration, on the other hand, of the *Brephinae* to an independent position.

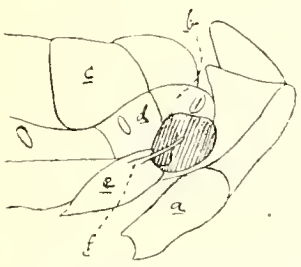
Most of the terms used in our descriptive work are such as are in common use among entomologists and will not be here defined. By « palpus » is always to be understood « labial palpus », according to general custom. Our nomenclature of the wing-veins (see **Plate, Fig. I**) is the same as in Rothschild & Jordan's *Sphingidae* (*Gen. Ins.* Fasc. 57), although there is much to be said for

Woodworth's (1) resuscitation of the term « independents » for the three radials (veins 6, 5, 4 of Herrich-Schäffer), and perhaps for his other changes of name. By « discocellulars », when the word is employed without further qualification, is to be understood the two middle ones (DC^2 and DC^3). The « areole », or « accessory (auxiliary) cell », to which reference has already been made in connection with Lederer's system, is found above the distal part of the true cell in the forewing, and whatever its real morphology, will be here treated (after Meyrick) as due to anastomosis among veins SC^1, SC^2 and SC^3. A simple or single areole may be formed by anastomosis of SC^1 with the stalk of the others, or of SC^2 (arising out of SC^1) wit that of SC^3, and there is no reason why the term should not also be applied to the results of simple anastomosis of SC^{1-2} or of SC^{2-3}; a double areole is formed by anastomosis of SC^2 first with SC^1 and then with SC^3, whether SC^2 arise out of *cell* (making the proximal areole the smaller) or out of stalk of SC^{3-5} (making the distal smaller).

The family is of great extent, and it is impossible at present to estimate even approximately the number of species or of genera composing it. Its distribution is worldwide, and all the great faunistic regions are more or less rich in species, although in some parts of the southern hemisphere (parts of Africa, Argentina, etc.) it comes far behind the *Pyralidae* in point of numbers. Various northern species are common to Europe and North America, but only one or two species, such as *Orthonama fluviata*, Hübner, are nearly cosmopolitan.

General Characters of the Family. — The *Geometridae* as at present constituted may be characterized as follows : Small or moderate-sized (rarely large) moths, usually of slender build, the wings generally ample in proportion to the size of the body. Ocelli usually ill-developed or obsolete. Labial palpus usually porrect, rarely very stout, third joint rarely very long and scarcely ever with remarkable modification of shape or scaling. Maxillary palpus ill-developed, single jointed, or very rarely (*Ligdia*, ? etc.) with two joints. Tongue usually well-developed, though not abnormally long, the

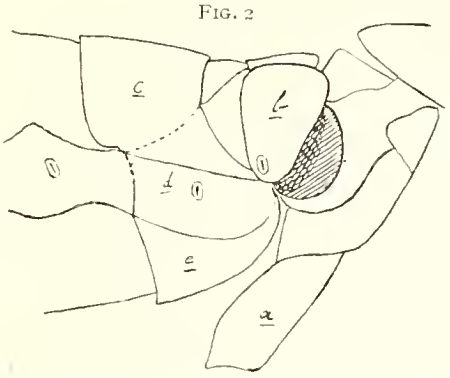
FIG. 1



a, bindcoxa; *b*, reduced pleura of first abdominal segment *c*, tergite of second segment; *d*, pleura of second segment, receiving the abdominal cavity; *e*, sternite of second abdominal segment; *f*, spine from ditto, projecting free over cavity.

Diagram of anterior part of abdomen of a Geometrid (*Sabulodes boarmidaria*, Oberthur), showing position of basal cavity (marked dark).

FIG. 2



a, hindcoxa; *b*, swollen pleural plate of first abdominal segment, with cavity beneath (tympanum); *c*, *d*, *e*, second abdominal segment : tergite, pleura, sternite.

Diagram of anterior part of abdomen of an Aganaid, sens. lat. (*Nyctemera consobrina*, Hopffer), showing position of basal cavity (marked dark).

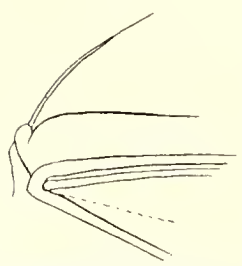
terminal papillæ (« Saftbohrer ») with radial plates (2); occasionally (*Amphidasiicae*, etc.) obsolete. Antenna usually slender, variable in structure, but the shaft generally setiform, scarcely ever clavate or fusiform, a tendency to thickening distally being observable only, so far as we are aware, in *Cistidia* and in *Rhopalodes* and a few allied genera; usually closely scaled to the apex, commonly powdered or ringed

(1) « The Wing Veins of Insects », *Univ. Calif. Techn. Bull. Ent.* Vol. 1, n° 1 (1900).
(2) Vide Breitenbach, *Jena. Zeit. Nat.* Vol. 15, p. 195.

with dark scales. Thorax generally short, rarely crested, never so anteriorly. Tegulæ usually rounded, very rarely squared or rectangular. Abdomen with pleura of first segment reduced, pleura of *second* segment swollen to receive the basal cavity (the so-called « tympanum »), hence with the first stigma *above* the cavity(1) (**Fig. 1, 2**). Legs usually slender, foreleg well-developed. Femora seldom densely hairy. Hindtibia scarcely ever strongly hairy, but that of the ♂ often dilated and with a furrow or pocket on the inner side near the femoro-tibial joint, containing an expansible pencil of hairs (**Plate, Fig. 2**), a spinelike process from the sternite of the second abdominal segment (**Fig. 1, *f***) correlated with the development of this hair-pencil, evidently employed in the process of spreading it out. Tarsi usually long, not hairy, hindtarsus occasionally abbreviated in those species in which the hindtibia is much dilated. Frenulum usually present, aborted or wanting in a few specialized genera. *Venation :* DC^3 usually oblique outwards, especially in hindwing, sometimes angulated outwards at the point of origin of R^2, especially in hindwing. Forewing with four or five subcostals(2), SC^4 and SC^5 stalked, usually with SC^3 also (3), anastomosis among subcostals very frequent; R^2 from discocellulars (usually from about middle or nearer to R^1 than to R^3), occasionally (*Melanchroia*, etc.) stalked with R^1, never (4) connate with or closely approximated at its base to R^3, SM^1 wanting, SM^3 short, usually running into SM^2, sometimes weak or wanting. Hindwing with C making a more or less prominent bend into the humeral angle (5), usually forked with a rudimentary vein running from near base of frenulum, never subparallel basally to SC; R^2 variable in position, but not connate with R^3, often weak or wanting; SM^1 wanting (represented by a fold in the wing), SM^3 usually short and running into inner margin, far more rarely running to distal.

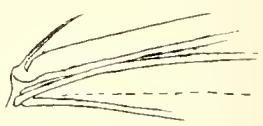
The distinctive characters in the venation are : 1° the stalking of SC^4 with SC^5 in forewing; 2° the origin of R^2 of forewing apart from R^3; 3° the basal bend of C of hindwing; 4° the absence of SM^1. The first of these affords a ready means of separation from the *Uraniidae* and *Epiplemidae;* the second from Geometriform *Noctuidae, Drepanidae, Aganaidae* (*Hypsidae*), etc.; the third from *Notodontidae* and *Dioptidae* (see **Fig. 3, 4**); the fourth from *Pyralidae*. A few *Polyplocidae* which have been erroneously classed as *Geometridae* may be distinguished by the close approximation of C of hindwing to SC beyond the cell. As the delimitation of *Notodontidae* from the more robust among the *Geometridae* has sometimes proved a matter of difficulty, it may be pointed out that the short, often strongly hairy tarsi of the former, a tuft of hairs at the base of their antennæ, their generally more hairy body and wings, broader face, narrow forewing, relatively smaller hindwing, will usually be found helpful; while in many cases hairy eyes, upturned palpi, tuft of scales on inner margin of forewing, or other features not known, or scarcely known in the *Geometridae*, will afford further clues. In the venation, a connective bar between C and SC of hindwing towards middle of cell, without the special features which make the *Larentiinae* so easy to recognize, would indicate *Notodontidae;* while any intricate anasto-

Fig. 3.



Humeral angle of hindwing of a Notodontid, *Pheosia tremula*, Clerck, ♂.

Fig. 4.



Humeral angle of a Dioptid, *Phaeochlaena tendinosa*, Hübner, ♂.

(1) Vide Jordan, *Nov. Zool.* Vol. 12, p. 506, for a note on this evidently valuable taxonomic character.

(2) Except in *Goniacidalia*, which we have not yet been able to study.

(3) In the *Brephinae* SC^{3+4} are often coincident, and a similar occurence is sometimes found in *Apocheima pomonaria*; but as SC^5 is still stalked therewith, this is not exceptional from the family character. In two or three genera of *Larentiinae* (*Cataclysme, Mesotype, Zenophleps, Acodia*) a real exception occurs, resulting in the severance of SC^5 from the other subcostals, as will be explained under that subfamily.

(4) Except in *Mimaletis, Geodena, Ereutenea, Astyochia, Parallage*, and perhaps a few allies, some of which may possibly be later removed from this family. In *Cartaletis*, too, the position of R^2 varies; while in two or three Larentiine genera (*Operophtera*, etc.), where DC^3 is angled, the shortening of its lower part also leads to an approach between R^2 and R^3.

(5) Especially in the *Larentiinae* and some others; see **Plate, Fig. 1a**. Hardly noticeable in a few of the archaic Australian forms; compare the anomalous *Diceratucha* etc.

mosis of the subcostals of forewing, and in particular any contact of SC^1 with C or with SC^2, would point rather to *Geometridae*.

Von Gumppenberg (*Nova Acta Acad. German.* Vol. 49, p. 275, 277) thinks the form of the scales may yield differential characters in the *Geometridae*, and recommends their study. Schneider (*Zeitschr. Ges. Nat.* Vol. 51, p. 58) has touched this subject, and notes that there are, in general, prevalent types of scales for particular families, but does not pursure the research to subfamilies or genera. Characteristic for the *Geometridae* are scales with their lateral margins parallel distally, strongly convergent basad, marked by lateral striping (often ribbing), usually three- to six-toothed, the external teeth often longer than those between. Our own very limited observations suggest that broad (five- to six-toothed), well-ribbed scales are chiefly characteristic of *Larentiinae* and *Geometrinae* (= *Boarmiinae*, Hampson), smaller, narrower ones of the other subfamilies; but no sufficient investigations have yet been made.

According to Packard (*Mon. Geom. U. S.*, p. 17, 24, 26, 28, 32, 34) the *Geometridae* show also reliable distinguishing features in the anatomy of the head and thorax, and it is possible he may be right, though here again is a subject which has not been followed up; his own work is too ill-digested and inconclusive to be utilized here, and results in his removing from the family such undoubted Geometrids as *Euphanessa* and *Pachycnemia*.

Early Stages. — Egg usually ovoid in form, belonging to the « flat egg » division of Chapman (long axis normally horizontal, or nearly so, micropyle at one end of this long axis). Only quite exceptionally (*Ourapteryx* (1) ? etc.) is there a genuine approach to the « upright » type of egg. The sculpturing varies from being almost imperceptible to a strong hexagonal or polygonal pitting (Plate, Fig. 3), or in some cases longitudinal ribbing. Larva often bearing strong protective resemblance to twigs, specialized by the abortion or complete loss of some of the ventral claspers (prolegs) (Plate, Fig. 4); with very few exceptions, only those on the sixth and tenth abdominal segments persist, but in a few genera, such as *Colotois* (= *Himera*), *Campaea*, *Ellopia*, *Opisthograptis*, *Gonodontis*, *Declana* and some *Oenochrominae*, there is an additional pair on the fifth segment (in *Gonodontis* and *Opisthograptis* (2) also another pair on the fourth), though usually rudimentary, while in *Brephos* all the prolegs are present, but the first two pairs rudimentary and even the third pair not perfectly developed, hence scarcely disturbing the « ground-measuring » mode of progression which has given the family its name. The anal pair always strong, true « claspers », directed ventrad, not caudad as in many Lepidoptera. Pupa « obtect », with only the fifth and sixth abdominals free, and without power of progression. Not yet much studied in classificatory work on the family.

Subdivision of the Family. — If superfamily rank were given to the *Geometridae* (as has been done by Comstock, Hulst and Tutt explicitly, and by Herrich-Schäffer, Guenée, Poppius, Meyrick and others implicitly), three coördinate families might be admitted, as already indicated (in our historical account of the system of Herrich-Schäffer), and these divided again into subfamilies and tribes; but no artificial system, however elaborate, can connote all the grades of natural relationship, even in those very rare cases in which these are sufficiently well understood. In order to bring this section of the *Genera Insectorum* more nearly into line with others, we shall merely indicate the main groupings as follows, and deal with the *Geometridae* as consisting of six subfamilies.

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(1) Tutt, *Ent. Record*, Vol. 16, p. 54, Vol. 20, p. 201, shows that *Catascia myrtillata*, Thunberg (= *obfuscaria*, Hübner) has also, in a sense, an upright egg, but the descriptions (*Ent. Record*, Vol. 15, p. 339, Vol. 16, p. 54, Vol. 17, p. 162) make it clear that this is accidental only. Many « flat eggs » become accidentally « upright » by being attached at or near the nadir, without otherwise losing their characteristics. Again, the *Ennomos* eggs laid side to side may stand vertical to some twig which is not so much the governing factor in position as the previously-laid egg. So, too, is it with *Alsophila*.

(2) And in some Australian species, according to Anderson, *Vict. Nat.* Vol. 9, p. 91, who further states that *Mnesampela* larvæ are quite Noctuid in appearance, and with the full complement of prolegs.

Group A. — Vein R^2 of hindwing present, usually well developed, costal very rarely anastomosing with subcostal (1). Subfamilies *Brephinae, Oenochrominae* (= *Monocteniadae* and *Orthostixidae*, Meyrick), *Hemitheinae* (= *Geometridae*, Meyrick) and *Acidaliinae* (= *Sterrhidae*, Meyrick).

Group B. — Vein R^2 of hindwing well developed, C either anastomosing strongly with SC or (far more rarely) connected therewith by a bar beyond middle of cell. Subfamily *Larentiinae* (= *Hydriomenidae*, Meyrick).

Group C. — Vein R^2 of hindwing wanting, or reduced to a mere fold or thickening of the wing-membrane (non-tubular). Subfamily *Geometridae* (= *Selidosemidae*, Meyrick).

The four subfamilies placed under Group A do not admit of absolutely rigid definition by venation, occasional anomalies or intermediates occurring; nevertheless the following scheme holds for the overwhelming majority of cases, and leaves only occasional exceptions to be studied as they arise.

1. *Veins* SC^3 ^{4} *of forewing coincident or both running into costa* (2) . . . . . Subfam. Brephinæ.
   Vein SC^4 *of forewing not coincident with* SC^3, *running into apex or distal margin* . . . . . 2.
2. *Vein* R^2 *of hindwing (often also of forewing) arising much nearer to* R^1 *than to* R^3 Subfam. Hemitheinæ.
   Vein R^2 *of hindwing usually (and of forewing nearly always) arising from near middle of discocellulars* (3) . . . . . 3.
3. *Vein* C *of hindwing shortly fused with* SC *at a point near base* (4); C *of forewing free*, SC^1 *not free from* SC^2. . . . . Subfam. Acidaliinæ.
   Vein C *of hindwing usually free from* SC *throughout, sometimes connected therewith by a bar near base;* C *of forewing often anastomosed or connected with* SC^1; SC^1 *often free from* SC^2. . . . . Subfam. Œnochrominæ.

With regard to the nomenclature adopted, the generic names have been carefully revised in accordance with the International Code (5), and subfamily and tribal names — on which the Code is less definite — have, where practicable, been subjected to the like rules; that is to say, all family, subfamily and tribal names which have been proposed have been treated as of equal rank in nomenclature, and the law of priority has been observed in selecting those which are applicable, although necessarily a termination may have to be changed from *-idae* or *-idi* to *-inae* or *-icae*. The principle of a « type genus » for each subfamily, as set forth in the Code (Art. 4, 5) has been accepted, so that the inclusion of older (but non-typical) generic names does not invalidate that of a subfamily; e. g., *Hipparchus*, Leach (1815) in the subfamily *Hemitheinae*, Bruand (type *Hemithea*, Duponchel, 1829). In only one instance has a slight sacrifice been made to common usage, namely : the generic name *Phalaena* having been supplanted by *Geometra* (see supra) we consider it necessary to employ *Geometridae* and *Geometrinae* for *Phalaenidae* and *Phalaeninae*. The type of the genus *Geometra* (*Phalaena*) is *syringaria*, Linnæus, as has been shown by Kirby & Smith (*Proc. Internat. Congr. Zool.* 1898, App. A, p. 321); certainly no author prior to Lamarck (1801) attempted to « select a type » according to the requirements of the International Commission on

(1) The few exceptions will be noticed in their places.

(2) The small, oval eyes, long-haired face and legs etc. distinguish the *Brephinae* more readily than the venation; yet the position of SC^4 and SC^5 and the frequent disappearance of SC^3 are fairly characteristic.

(3) The exceptions are commonest, and most difficult, in the ill-defined assemblage *Œnochrominae*; see *Aplasta, Heliothea, Petovia, Marcodava, Monoctenia Œnochroma, Cernia, Hypographa*. In a few *Acidaliinae* in which the position of R^2 is Hemitheine (*Asellodes, Dasybela* etc.) the forewing venation (presence of areole, position of SC^2) is decisive.

(4) Occasional irregularities in the *Cyllopodicae* make that tribe resemble certain *Œnochrominae* in hindwing venation; but the sections to which they show most analogy (*Œnochromicae*, Groups II and III) almost invariably have C of forewing anastomosing or connected with SC^4, while in the *Cyllopodicae* it is free. Where the hindwing venation fails, a combination of aborted ♂ leg-structure with freedom of C and presence of areole will point to *Acidaliinae*. On an *ensemble* of characters, we therefore refer the *Cyllopodicae* to this last-named subfamily.

(5) The date given in brackets after our citation of the type of each genus is that at which such type became definitely fixed. The bibliographic reference for such fixation is always included in the synonymy. Where no date follows the type-citation, the selection is our own.

Nomenclature, and although Lamarck himself does not use the actual word « type », he definitely expresses his purpose of elucidating the genera by citing under each of them one well-known species etc. No useful purpose could be served by attempting to override Kirby's decision, for in 1810 Latreille actually cited *sambucaria*, Linnæus, as « type », and if this were adopted the familiar name of *Ourapteryx*, Leach, would be lost, while in any circumstances it is impossible to retain Treitschke's conception of *Geometra*. Billberg in 1820 (*Enum. Ins. in Mus. Billb.* p. 89) restricted *Geometra* in such wise as to include both *syringaria*, Linnæus, and Leach's *Geometra* (*Selenia*, Hübner, etc.).

On the relative value of various characters as generic or non-generic, systematists are not, and probably never will be in accord. We have endeavoured to avoid the two extremes — unwieldy genera which one feels must surely, when more thoroughly understood, prove to contain heterogeneous biological elements; and subdivisions founded on slight, intangible, or evidently inconstant imaginal distinctions. But where genera which might be considered open to the latter charge have *already* obtained some currency (e. g., *Oenochroma*, *Xyridacma*, *Barrama*, *Inurois*, etc.) we consider it expedient to maintain them so far as possible : i. e., when we find them susceptible of distinctive definition; for the general tendency of advancing knowledge is in the direction of the multiplication of genera, and premature « lumping » causes greater confusion than premature « splitting ».

SUBFAM. BREPHINÆ

Brephiæ. Hübner, Verz. bek. Schmett. p. 279 (1826 ?).
Phalænoidi. Guenée, Ann. Soc. Ent. Fr. Vol. 10, p. 217 (1841).
Phalænoidæ. Duponchel, Cat. Méth. Lép. Eur. p. 189 (1845).
Brephides. Herrich-Schäffer, Syst. Bearb. Schmett. Eur. Vol. 2, p. 449 (1851).
Brephidæ. Snellen, Vlind. Nederl. Macrolep. p. 505 (1867).
Monocteniadæ (part.). Meyrick, Proc. Linn. Soc. N. S. Wales (2), Vol. 4, p. 1136 (1890).
Brephinæ. Hulst, Trans. Amer. Ent. Soc. Vol. 23, p. 316 (1896).

A small group of somewhat anomalous moths, which have been variously placed by systematists. The older authors took them to belong to *Bombyx* or *Noctua*, and even in recent times they have continued to be erroneously associated with the *Noctuidae*, or by von Linstow, *Berl. Ent. Zeitschr.* Vol. 52, p. 193, with the « Bombyces ». Some modern writers have accorded them full family rank, and several have noticed their resemblances to the *Geometridae;* but von Gumppenberg, in 1887, and Meyrick (independently), in 1890, were the first to refer them definitely to this family, the latter assigning them a position among his *Monocteniadae* (our *Oenochrominae*). They seem to represent either an archaic, or possibly a somewhat degenerate type. Only two genera, rather closely allied, are certainly known, though Möschler's diagnosis of the genus *Möschleria*, Saalmüller, suggests at least a possibility that a third — less nearly related in shape and antennal structure — may exist in the West Indies. The *Brephinae* show no appreciable affinity with the *Dioptidae*, nor indeed with any known family outside the *Geometridae;* their nearest relative among the *Oenochrominae* is probably the Australian genus *Dirce* (*Oenone* Meyrick) (1).

General characters of the Subfamily. — Head, thorax and abdomen more or less densely clothed with hair. Scaling of hindwing much mixed with hairscales. Eye small, oval. Face and palpus strongly long-haired. Palpus minute, concealed by the frontal hairs. Antennal shaft more or less hair-scaled. Tongue present. Legs short, femora and tibiæ long-haired, tibial spurs very short. Tarsi strongly spinulose. Frenulum present. Forewing usually with eleven veins, SC^{3+4} coincident or only separating shortly before apex, running into costa; hindwing with SC^{2} very generally stalked with R^{1}, R^{2} weak and slender, sometimes obsolescent.

The distinctive features of the subfamily, apart from those of the venation, are the small *oval* eye (see Plate, Fig. 5), very *small*, densely *hairy* palpus and hairy tibiæ, together with the sixteen-legged larva.

Geographical distribution of species. — Palæarctic and Nearctic.

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(1) *Dirce*, Prout, nov. nom. = *Oenone*, Meyrick, *Proc. Linn. Soc. N. S. Wales* (2), Vol. 4, p. 1194 (nec Savigny, 1817).

KEY TO THE GENERA

Hindwing with R^3 *and* M^1 *stalked* . . . . . 2. Genus Leucobrephos, Grote.
Hindwing with R^3 *and* M^1 *not stalked* . . . . . 1. Genus Brephos, Zincken.

1. Genus BREPHOS, Zincken

Brephos (Ochsenheimer, Schmett. Eur. Vol. 4, p. 96 (1816) indescr., ex Hübner, Tentamen, ined.): Zincken, Ersch & Gruber's Allg. Encycl. Wissensch. Vol. 12, p. 365 (1824).

Archiearis. Hübner, Verz. bek. Schmett. p. 279 (1826?).

Brepha. Curtis, Brit. Ent. Vol. 3, p. 121 (1826).

Catoxanthia. Sodoffsky, Bull. Soc. Nat. Moscou Vol. 6, p. 16 (1837).

Characters. — Palpus very small, third joint ovate. Antenna about one-half length of forewing, in ♂ either bipectinate with short clavate pectinations, or somewhat moniliform and shortly ciliated, in ♀ rather slender, nearly simple, pubescent. Legs short, hairy. Hindtibia in both sexes with all spurs present, short; that of ♂ with small hair-pencil (Plate, Fig. 6). Hindtarsus rather short and thick, strongly spinulose. ♂ genitalia with harpe simple, without trace of clasper or ampulla, uncus articulated to the tegumen, below the uncus a plate with subdentate or spinose edge (Pierce, *Genit. Noct.* p. 83, t. 32). Wing-expanse(1) 26-37 mm. Forewing rather narrow, angles well pronounced, costa slightly arched near base, then nearly straight, distal margin convex, somewhat oblique in ♂, less so in ♀, inner margin rather long, straight, cell more than half length of wing(2), SC^1 free, SC^2 out of stalk of SC^{4+5}, SC^3 often absent (remaining coincident with SC^4), SC^{4+5} (or SC^{3+5}) stalked from apex of cell, R^2 rather slender, M^1 approximated at its base to R^3; hindwing with cell long, C^1 closely appressed to SC for a distance, but not anastomosing, SC^2 and R^1 long-stalked, short-stalked or (rarely) connate, R^2 weak, sometimes obsolescent (especially in *notha*), M^1 connate with R^3, very rarely separate, SM^3 to inner margin rather near tornus.

Larva. — Setæ greatly reduced, but tubercles remaining rather distinct, normal in arrangement, without secondary hairs. All abdominal legs present, but three anterior pairs about half aborted (Dyar, *Journ. New York Ent. Soc.* Vol. 3, p. 21).

Pupa. — Anal armature terminated in a curious transverse process (*Cambridge, Nat. Hist.* Vol. 6, p. 416, f. 205).

Type of the genus : *Brephos notha* (Hübner) = *Noctua notha*, Hübner = *Brepha parthenias*, Curtis (nec Linné) (1826).

Geographical distribution of species. — Palæarctic and Nearctic.

Section I. — Forewing with SC^{3+4} usually stalked; hindwing with SC^2 and R^1 connate or quite short-stalked; ♂ with antenna pectinated(3). (Plate, Fig. 7, 10).

1. *B. notha* (Hübner). Europe, Central Asia, Algeria.
Bombyx vidua, Fabricius, Syst. Ent. p. 580 (1775) (nec Poda, 1761).

(1) It is not implied that size is a character of generic value, but rough measurements (from tip to tip of forewing, average setting) are given here and throughout because experience shows that they are frequently helpful as a partial clue in determination; it is rarely indeed that close congeners deviate extremely in size.

(2) The length of the cell is always to be reckoned to the cell-spot or approximately the middle of the discocellulars.

(3) It would probably be justifiable to make two genera of our two sections; but the species seem so closely related biologically that we prefer to minimize the imaginal differences. We figure details from both sections.

Phalaena parthenias, Donovan, Brit. Ins. Vol. 7, p. 81, t. 246 (1799) (nec Linné).
Noctua notha, Hübner, Samml. Eur. Schmett. Noct. t. 74, p. 343, 344 (1802?).
Bombyx parthenius, Haworth, Lep. Brit. (1), p. 135 (1803).
Hemigeometra parthenias, Haworth, ibidem, (2), p. 269 (1809).
Brephos notha, Ochsenheimer, Schmett. Eur. Vol. 4, p. 96 (1816).
Archiearis notha, Hübner, Verz. bek. Schmett. p. 280 (1826?).
Brepha parthenias, Curtis, Brit. Ent. Vol. 3, p. 121 (1826).
[*Brephos*] *parthenioides*, nom. ined., fide Treitschke, Schmett. Eur. Vol. 5 (3), p. 384 (1826).
Brephos vidua, Speyer, Stett. Ent. Zeit. Vol. 24, p. 95 (1863).
Brephos nothum, Staudinger, Cat. Lep. (ed. 2), p. 143 (1871).

2. *B. puella* (Esper). — **Plate, Fig. 12.** — Central Europe.
Noctua puella, Esper, Schmett. in Abbild. Vol. 4 (1), t. 106, f. 2, 3 (1787); p. 163 (1789).
Phalaena Noctua caelebs, Hübner, Beitr. Vol. 1 (4), p. 21, t. 3, f. ♀ (1789).
Noctua spuria, Hübner, Samml. Eur. Schmett. Noct. t. 64, f. 345 (1802?).
Brephos puella, Ochsenheimer, Schmett. Eur. Vol. 4, p. 96 (1816).
Archiearis spuria, Hübner, Verz. bek. Schmett. p. 280 (1826?).
Archiearis puella, Walker, List Lep. Ins. Brit. Mus. Vol. 12, p. 842 (1857).

SECTION II. — Forewing with SC^{3-4} connate; hindwing with SC^{2} and R^{1} long-stalked; ♂ with antenna not pectinated. (**Plate, Fig. 8, 11.**)

3. *B. parthenias* (Linné). — Europe, Siberia, Kamtschatka.
Phalaena Noctua parthenias, Linné, Faun. Suec. p. 308 (1761).
? *Phalaena Noctua plebeja*, Linné, ibidem, p. 320 (1761).
Phalaena fulvulata, Pallas, Reise, Vol. 2, p. 732 (1773).
Phalaena Noctua glaucescens, Goeze, Ent. Beytr. Vol. 3 (3), p. 206 (1781).
Phalaena Geometra glaucofasciata, Goeze, ibidem, p. 387 (1781).
Noctua parthenias, Esper, Schmett. in Abbild. Vol. 4 (1), t. 85, f. 6 (1786); p. 53 (1787?).
Hemigeometra notha, Haworth, Lep. Brit. p. 269 (1809) (nec Hübner).
Brephos parthenias, Ochsenheimer, Schmett. Eur. Vol. 4, p. 96 (1816).
Archiearis parthenias, Hübner, Verz. bek. Schmett. p. 280 (1826?).
Brepha notha, Curtis, Brit. Ent. Vol. 3, p. 121 (1826).
Brephos parthenias, ab. *passetii*, Thierry-Mieg, Le Naturaliste, Vol. 6, p. 437 (1884) (ab.).

4. *B. infans*, Möschler (præc. var.?) — **Plate, Fig. 13.** — North America.
Brephos parthenias, Möschler, Wien. Ent. Monats. Vol. 4, p. 371 (1860) (nec Linné).
Brephos infans, Möschler, ibidem, Vol. 6, p. 134, t. 1, f. 6 (1862).
Archiearis infans, Grote & Robinson, Trans. Amer. Ent. Soc. Vol. 1, p. 189 (1867).
Brephos hamadryas, Harris, fide Grote & Robinson, ibidem (1867); Ent. Corr. p. 174, t. 1, f. 4 (1869).
Brephos infans et ? var. *hamadryas*, Speyer, Stett. Ent. Zeit. Vol. 36, p. 171, 351 (1875).
Brephos parthenias, var. *infans*, Snellen, Tijdschr. v. Ent Vol. 29, p. 137 (1886).

5. *B. fletcheri*, J. B. Smith, (huj. sect. ?). — British Columbia.
Brephos fletcheri, J. B. Smith, The Canad. Entom. Vol. 39, p. 370 (1907).

NOTE. — Two other species originally erected under *Brephos* have been a source of considerable trouble to our North American entomologists, and their identification has not even yet been thoroughly established. These are *Brephos melanis*, Boisduval, and *Brephos californicus*, Boisduval (*Ann. Soc. Ent. Belg.* Vol. 12, p. 88, 1869), both described from California. It was long ago suspected that they « are probably Arctians and do not belong here » (Grote, *The Canad. Entom.* Vol. 15, p. 56). Smith (ibidem, Vol. 39, p. 369) went a step further and endeavoured to identify them as species of *Leptarctia*. Dyar (ibidem, p. 411) showed that *Brephos californicus* might well be = *Leptarctia californiae*, Walker, and *B. melanis* a dark form

of *L. dimidiata*, Strecker; yet he does not wish the matter to be considered as absolutely closed, since it seems so strange that an entomologist of Boisduval's repute could have described under *Brephos* moths which he elsewhere shows he recognized as *Leptarctia*.

2. Genus LEUCOBREPHOS, Grote

Leucobrephos. Grote, Bull. Buff. Soc. Vol. 2, p. 53 (1874); The Canad. Entom. Vol. 15, p. 55 (1882).

Characters. — Head and palpus, thorax, abdomen and legs clothed with long, shaggy hairs; wing-scales also mingled with long hairs on the underside and at inner margin of hindwing above. Palpus minute or aborted (1). Antenna nearly one-half the length of forewing, in ♂ bipectinate from near base to apex. Legs short. Hindtibia with very minute terminal spurs, medians apparently wanting. Wing-expanse 24-30 mm. Forewing with cell very long, SC^1 free, SC^2 out of stalk of SC^{3-5}, SC^{2-4} coincident, or perhaps sometimes separating close to margin, M^1 connate or short-stalked with R^3; hindwing with cell very long, SC^2 stalked with R^1, R^3 long-stalked with M^1, only separating quite near termen (Plate, Fig. 9).

Type of the genus : *Leucobrephos brephoides* (Walker) = *Anarta brephoides*, Walker (1874).

Geographical distribution of species. — Siberia, Arctic America, British Columbia.

1. *L. brephoides* (Walker). — Plate, Fig. 14. — Arctic America to British Columbia, ? Wisconsin.
   - *Anarta brephoides*, Walker, List Lep. Ins. Brit. Mus. Vol. 11, p. 702 (1857).
   - *Archiearis resoluta*, Zeller, Stett. Ent. Zeit. Vol. 24, p. 137, t. 2, f. 1 (1863).
   - *Archiearis brephoides*, Grote & Robinson, Trans. Amer. Ent. Soc. Vol. 1, p. 188 (1867).
   - *Leucobrephos brephoides*, Grote, Bull. Buff. Soc. Vol. 2, p. 53 (1874).
   - *Melicleptria hoyi*, Grote, Bull. Brookl. Ent.Soc. Vol. 3, p. 30 (1880).
   - *Brephos middendorffii*, Möschler, Stett. Ent. Zeit. Vol. 44, p. 117 (1883) (nec Ménétriés).

2. *L. middendorfii* (Ménétriés) (præc. var. ?). — N. E. Siberia.
   - *Amphidasis middendorfii*, Ménétriés, Bull. Phys. Math. Acad. Sc. St-Pétersb. Vol. 17, p. 221 (1858).
   - *Amphidasys middendorffii*, Ménétriés, Schrenck's Reisen in Amur, Vol. 2, p. 66, t. 5, f. 9 (1859).
   - *Brephos middendorfii*, Staudinger, Cat. Lep. (ed. 2), p. 143 (1871).
   - *Leucobrephos middendorfii*, Grote, The Canad. Entom. Vol. 15, p. 55 (1882).

(1) If existent, it is entirely concealed by the dense hairs; we possess no material for closer investigation.

EXPLANATION OF PLATE

Fig. 1. Venation of a Geometrid (*Venodes napiaria*, Guenée). The figures in brackets showing the system of Herrich-Schäffer.

— 1*a*. Humeral angle of hindwing of a Geometrid (*Xanthorhoë montanata*, Schiffermüller), showing the basal angulation of vein C.

— 2. Hindleg of a Geometrid (*Microgonia rufaria*, Warren), showing the hair-pencil expanded.

— 3. Egg of a Geometrid (*Larentia multistrigaria*, Haworth).

— 4. A typical Geometrid larva (*Alcis repandata*, Linné).

— 5. Head of *Brephos notha*, Hübner, showing the oval eye.

— 6. Hindleg of *Brephos notha*, ♂.

— 7. Venation of *Brephos notha*, ♂.

— 8. Venation of *Brephos parthenias*, Linné, ♂.

— 9. Venation of *Leucobrephos brephoides*, Walker, ♂.

— 10. Section of antenna of *Brephos notha*, ♂.

— 11. Section of antenna of *Brephos parthenias*, ♂.

— 12. *Brephos puella*, Esper, ♀.

— 13. *Brephos infans*, Möschler, ♂.

— 14. *Leucobrephos brephoides*, Walker, ♂.

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